

DATA RESEARCH

meetup by MagIC

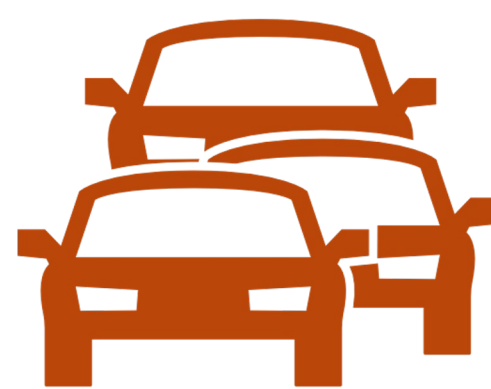
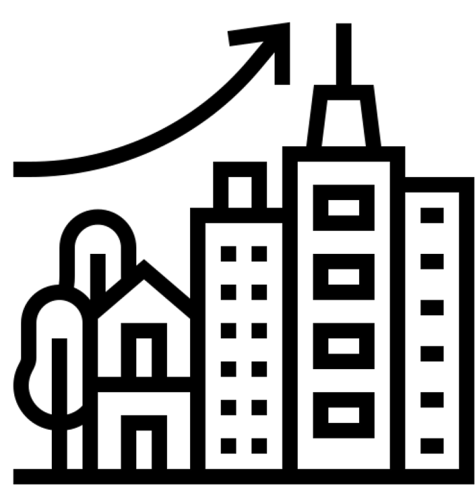


Application of Process Mining for Mobility and Transportation Analysis

Khristina Filonchik

NOVA Information Management School (NOVA IMS), NOVA Universidade de Lisboa

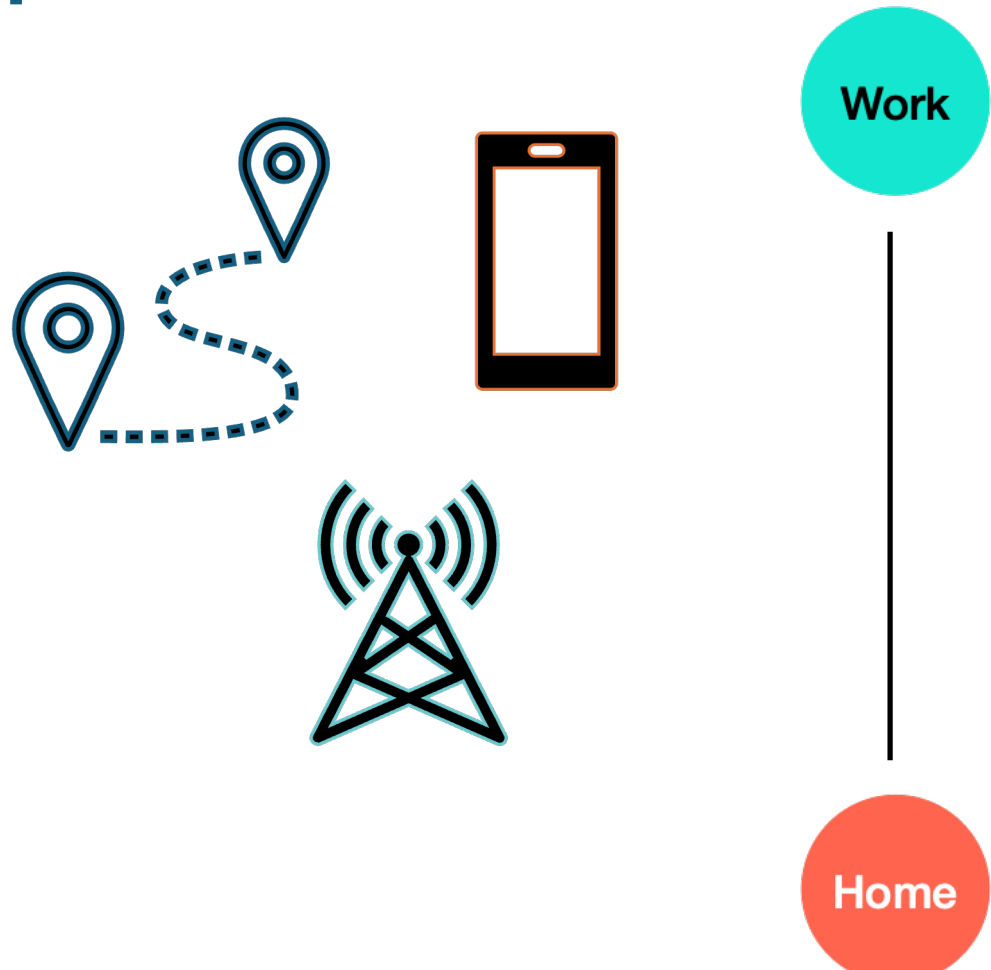
INTRODUCTION



The rapid urbanisation process has highlighted private transport modes, particularly cars, as one of the primary contributors to urban challenges

Explored Cities:

- New York
- San Francisco
- Beijing
- Shanghai
- Sydney
- Zürich
- Tokyo
- Montreal
- Rome
- Porto
- Singapur
- Jakarta



The widespread availability of sensor data from smartphones, has made mobility analysis possible. Routine mobility between home and work has been widely studied.

Research Objective

This research aims to **extend urban mobility analysis** by applying **process mining techniques**, commonly used in business context, to analyse travel behavior in urban spaces.

Why Process Mining?

Process mining can uncover hidden patterns in large datasets and provide a deeper understanding of mobility processes.

What's New?

Process mining (PM) has not yet made significant inroads in urban mobility analysis.

METHODS AND MATERIALS

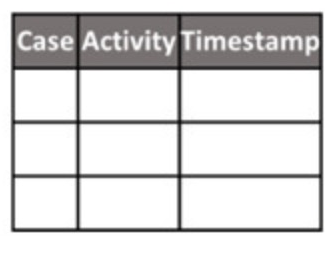


Travel diaries from Netherlands

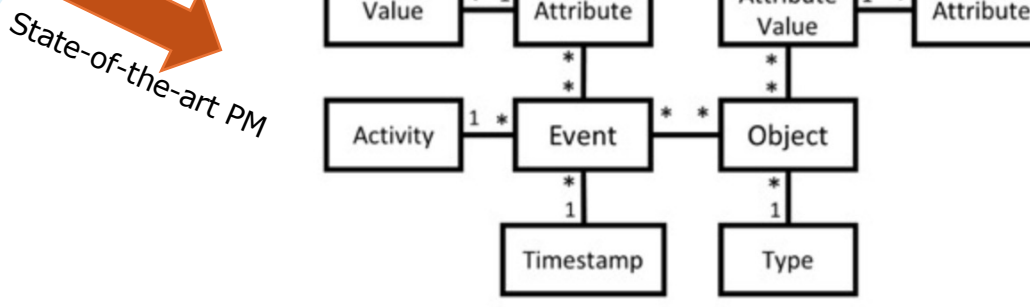


Mobile Phone Data Porto & Lisbon

$p_1 \rightarrow p_2 \rightarrow \dots \rightarrow p_n$
Extraction of travel trajectories



Traditional Event Log



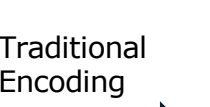
Object-centric Event Log



Process Executions as Sequences



Process Executions as Graphs



Traditional Encoding



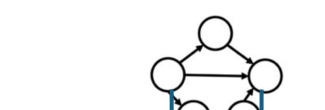
Graph Embedding



Direct Encoding



Graph-based ML Clustering



Graph Neural Networks



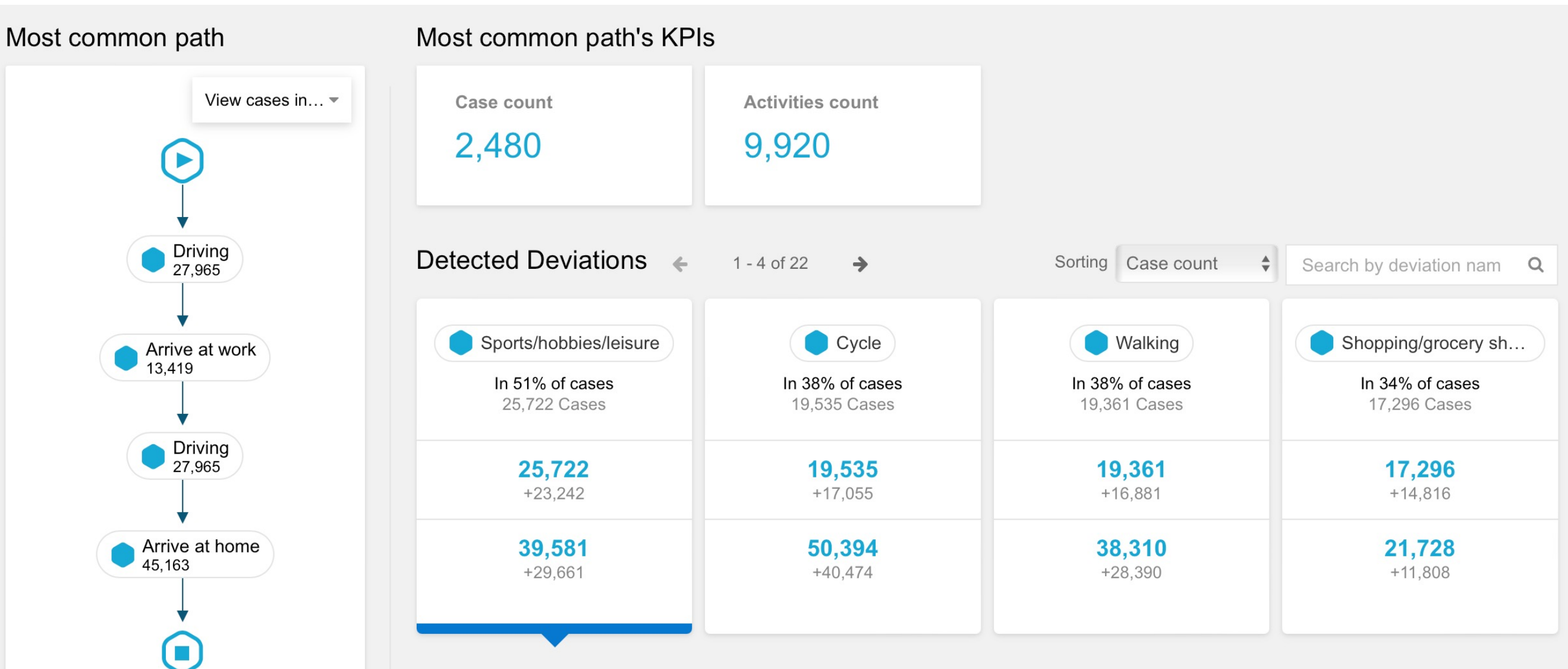
Output

REFERENCES

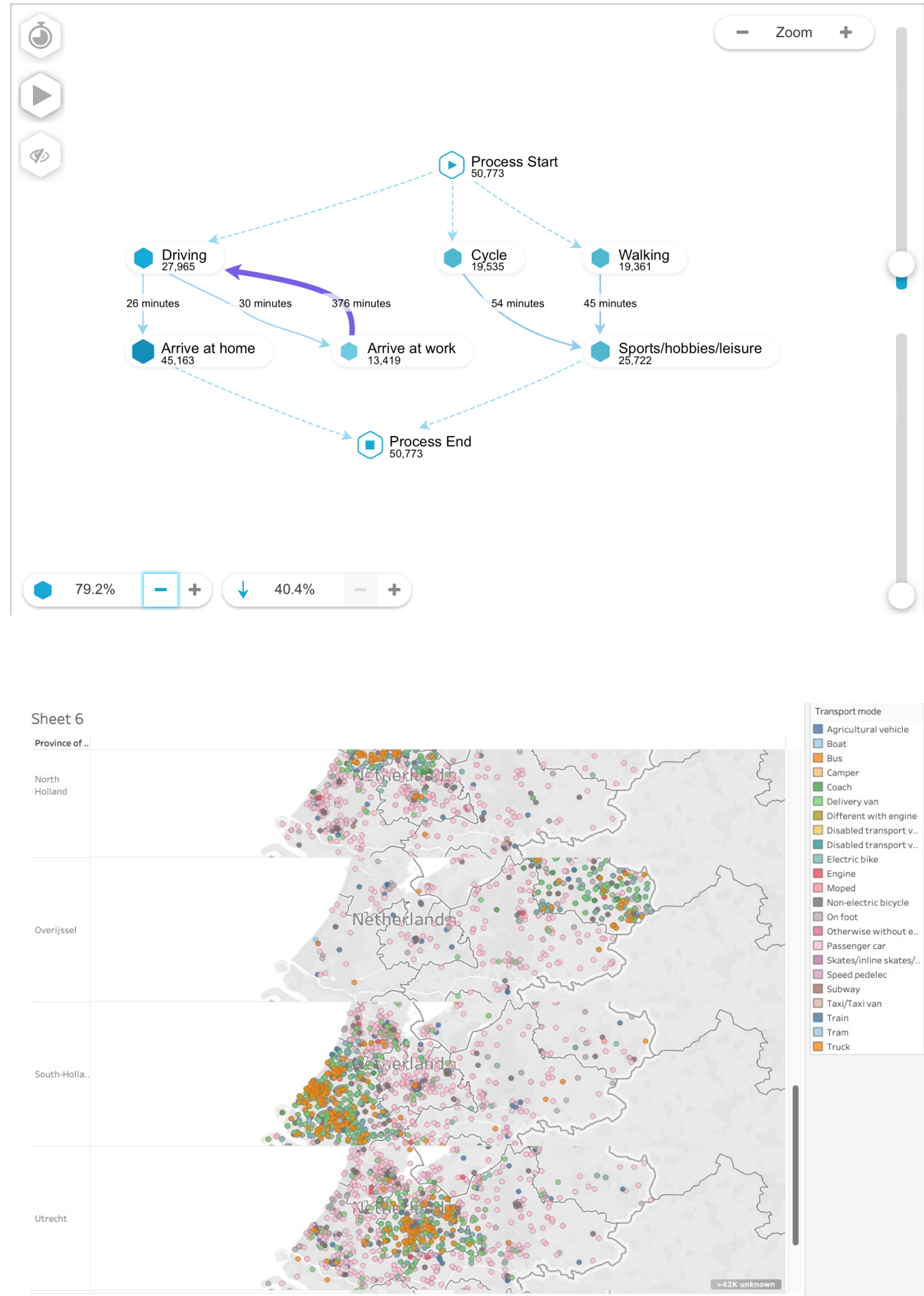
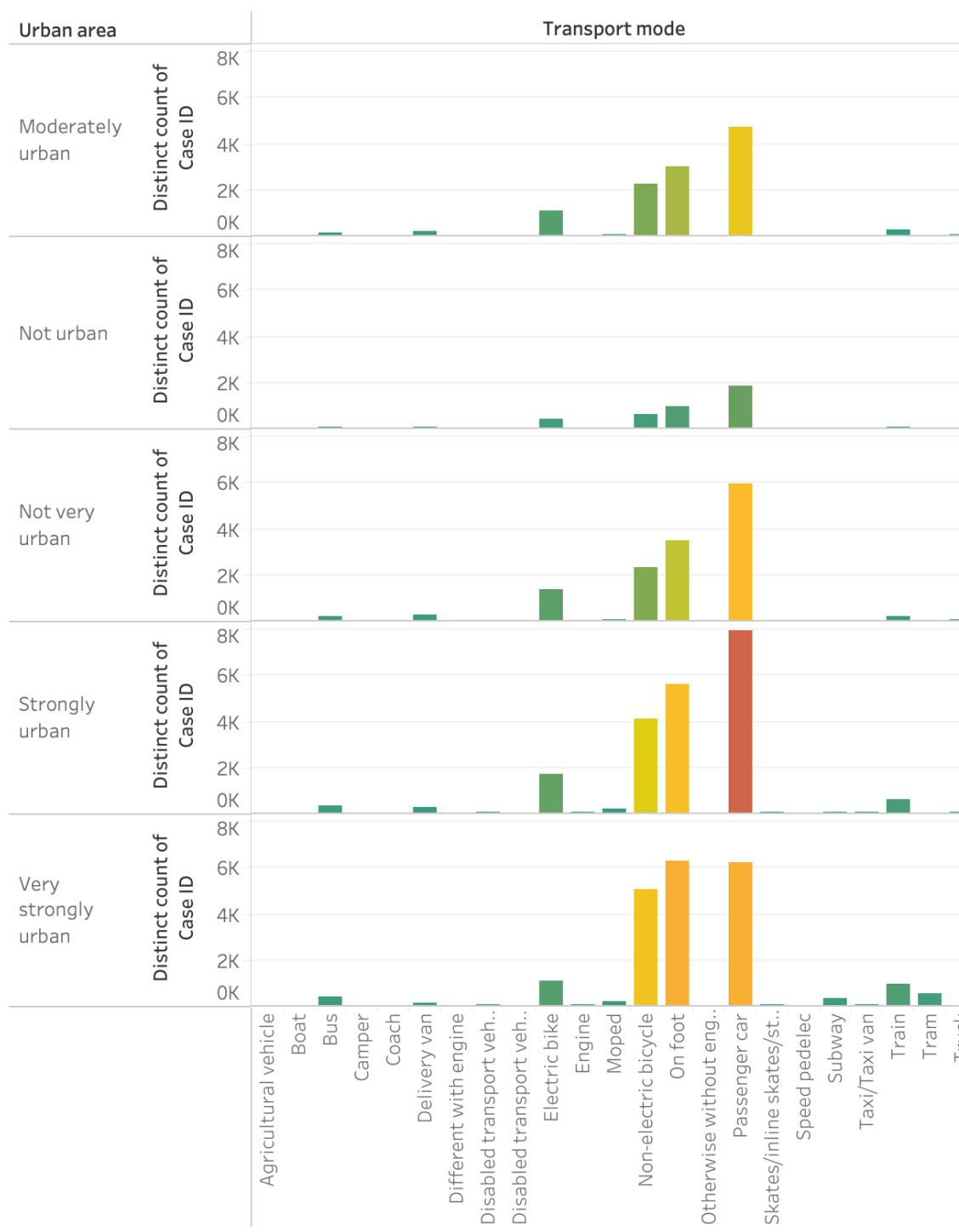
1. Jan Niklas Adams, Gyunam Park, Wil M.P. van der Aalst, "Preserving complex object-centric graph structures to improve machine learning tasks in process mining", Engineering Applications of Artificial Intelligence, Vol. 125, 2023
2. Berti, A., Herforth, J., Qafari, M.S. et al. Graph-based feature extraction on object-centric event logs. *Int J Data Sci Anal* **18**, 139–155 (2024)

FIRST RESULTS & DISCUSSION

From the **50,773 personal travel paths** analysed in the Netherlands, commuting between **home and work** is the most common pattern, **with 51% of cases** also involving participation in **sports or hobby activities**, supporting findings in the literature.



Cycling, walking, and driving are the three most common activities in personal travel sequences. **More than half of the participants** commute to work **using private motorized vehicles**.



Interestingly, in both very strong and strongly urban areas, **the passenger car remains one of the most popular modes of transport**.

CONCLUSION

Key Takeaways: The first results from **travel diaries** show that the data **can be represented as a traditional event log, revealing common paths and durations between activities** like commuting or sports. However, the sequences are too individual and require generalization or clustering to identify common flows.

Next Steps: Reduce **the number of unique activities** in the event log, then representing it as an object-centric event log for comparison with the traditional approach.

ACKNOWLEDGEMENTS

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